

Chapter 8. Goods Movement

This chapter presents information on four modes of goods movement in Arizona: truck, rail, air, and pipeline. The chapter provides an overview of the goods movement system and identifies the key links between goods movement and the Arizona economy. Appendix J, the *Goods Movement in Arizona Technical Memorandum*, provides additional detail regarding freight transportation.

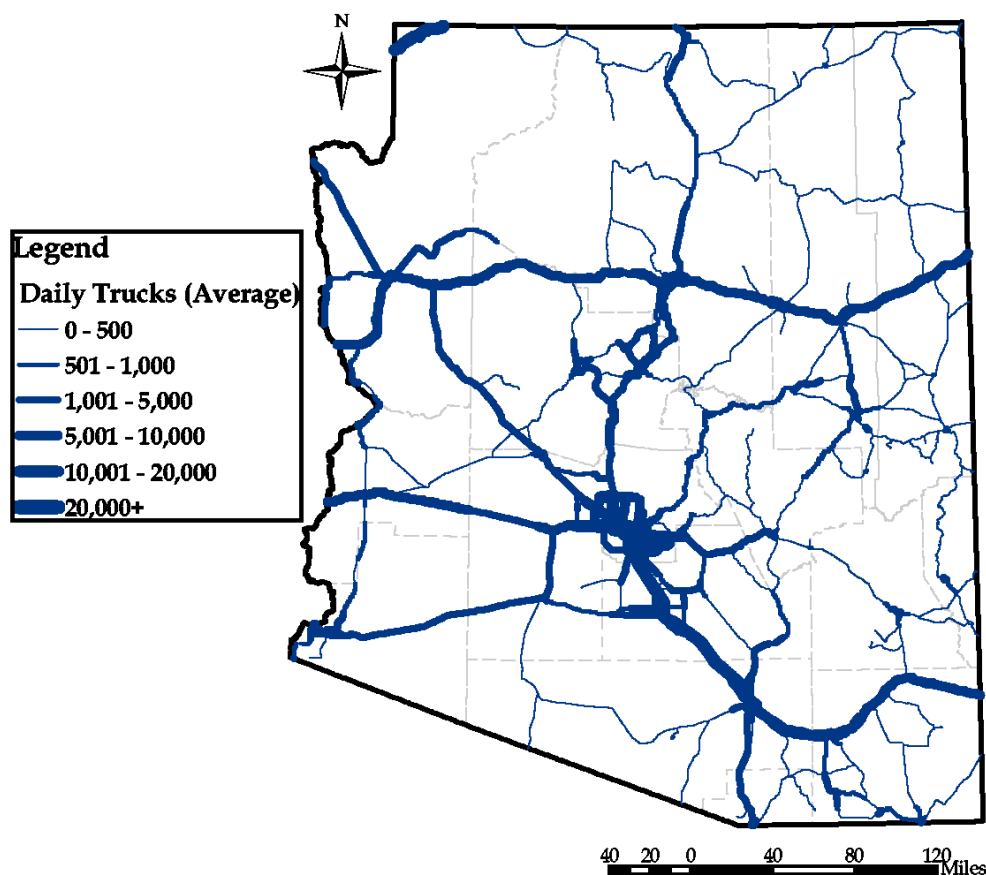
■ 8.1 Goods Movement System

The freight transportation system in Arizona includes commodity movements by truck, rail, air, and pipeline. Major individual components on the freight system include interstates and major U.S. and state routes, the BNSF and UP railroads, and Phoenix and Tucson International Airports. This section describes each of the components of the goods movement system, including highways, rail, airports, pipeline, and intermodal facilities to transfer goods between modes.

Highways

The freight highway system includes interstates, U.S. routes, and selected state routes. Local truck routes are also an important part of the freight system, providing access to collection and distribution points. Freight-hauling trucks account for about 12 percent of total VMT in Arizona. The highest truck volumes are found on the interstate system, particularly along a 100-mile stretch of I-10 between Phoenix and Tucson. Figure 8.1 shows daily truck volumes on Arizona's state highway system. As Arizona's economy changes, truck volumes on the state highway system are expected to grow from nearly 15 million miles per day to over 33 million miles per day (Table 8.1). Trucks traffic is expected to grow faster than automobile traffic over this period, increasing from 19 to 23 percent of total traffic on the state highway system.

Arizona has identified several key freight traffic routes, including the CANAMEX Corridor, a major corridor initiative to link Canada to Mexico through Arizona, Nevada, Utah, Idaho, and Montana. In Arizona, the CANAMEX Corridor route operates on I-19, I-10, and U.S. 93, with a bypass of the Phoenix metro area along I-8 and SR 85. Two segments of this corridor – I-10 from Tucson to Phoenix and U.S. 93 – have been designated by the Arizona Transportation Board as high-priority corridors for the State. Another major freight corridor in Arizona is the I-10 Coast-to-Coast Corridor from California to Florida.

Figure 8.1 Average Daily Truck Traffic on Arizona Highways in 2002

Source: Arizona Department of Transportation, Highway Performance Monitoring System, 2002.

Table 8.1 Estimated Daily Truck VMT, 2002 and 2025

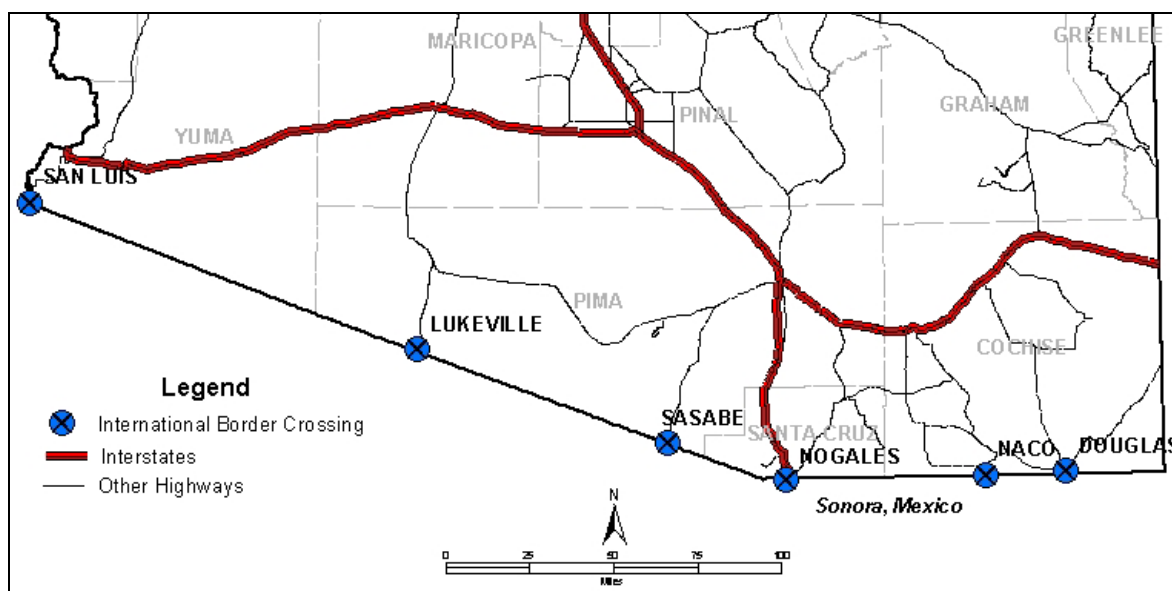
	2002	2025
Total VMT (State System)	77,879,600	142,551,400
Truck VMT (State System)	14,518,800	33,376,900
Truck Percentage of Total VMT	19%	23%

Source: Cambridge Systematics, Inc., 2003

Six ports of entry provide truck access between Arizona and Mexico: Douglas, Naco, Nogales, Sasabe, Lukeville, and San Luis (Figure 8.2). The Port of Nogales enjoys the most convenient highway access, with I-19 and SR 82 on the Arizona side and Mexican Federal

Highway 15 on the Sonora side. San Luis is served by U.S. 95 in Arizona and Mexican Federal Highway 2 in Sonora. Douglas is served by U.S. 191, SR 80, and Mexican Federal Highway 2. The remaining border crossings are served by undivided state highways, except for Naco, which is served only by local roads.

Figure 8.2 Arizona International Ports of Entry



Rail

As described in Chapter 7, Arizona's freight rail network consists of approximately 2,700 miles of track, including mainline, spurs, and yards. Freight and intercity passenger rail service share the same track in Arizona, but most of the tracks are owned and maintained by the UP and BNSF railroads.

Important segments of Arizona's rail network serve international freight traffic between Arizona and Mexico. UP's Nogales Branch, which runs between Tucson and Nogales parallel to I-19, connects with Grupo Ferrovial Mexicana (GFM) at the Arizona-Mexico border. GFM operates a north-south line linking Nogales with Hermosillo, and ultimately Mexico City. Shipments through Nogales include double-stack containers of automobile parts bound for the Ford/Mazda assembly plant in Hermosillo, and assembled automobiles from Hermosillo bound for the U.S.

Aviation

Of the 83 public-use airports in Arizona, Phoenix Sky Harbor and Tucson International Airports are the primary facilities used to transport air cargo. Sky Harbor International is the largest airport in the Phoenix/Mesa metropolitan area that maintains active schedules for inbound and outbound air freight. Sky Harbor provides nearly 200,000 square feet of space and over 100 air cargo bays for air cargo services.

Air cargo operations at Williams Gateway Airport include specialized services and unscheduled charter flights. To meet the growing demands of the east valley of metropolitan Phoenix and to relieve pressure at Sky Harbor, cargo service improvements are planned at Williams Gateway Airport. These include dedicated air cargo facilities, a cargo ramp, additional warehousing facilities, and a runway extension to accommodate air cargo aircraft. Table 8.2 shows the freight cargo volumes at Arizona airports for 2000.

Table 8.2 Cargo and Passenger Volumes at Arizona Airports, 2000

Airport	City	Cargo Gross Landed Weight (Tons)
Phoenix Sky Harbor International	Phoenix	920,400
Tucson International	Tucson	142,400
Total		1,062,800

Source: Federal Aviation Administration, 2000.

Pipeline

Pipelines provide an important conduit for energy resources in the State. Though pipelines provide transportation exclusively for selected commodities, they have an impact on other modes by reducing long-distance truck or rail trips for natural gas, petroleum, gasoline, and other petroleum-based products.

Arizona imports all of the petroleum products and natural gas used in the State. In 2002, nearly 126,000 barrels of refined petroleum products were imported from California refineries each day. Roughly one-half of this is gasoline, with the other one-half splits between jet fuel and diesel fuel. An additional 87,000 barrels of refined petroleum products were imported from El Paso and Gulf Coast refineries, of which over 85 percent were gasoline. The transportation sector uses almost 88 percent of petroleum products, compared to 66 percent nationally. Arizona uses almost no petroleum-based heating fuels.

Natural gas in Arizona is provided by 11 separate companies serving 900,000 customers. Three pipelines transmit natural gas around and through the State. Two pipelines

provide service in the north of the State, with service to Window Rock, Flagstaff, Kingman, and into California. A third pipeline provides service in the south through Willcox, Tucson, Casa Grande, Ehrenberg, and into California, with extensions to Nogales, Safford, Globe, Phoenix, and Yuma. All natural gas flows originate outside of the State and enter Arizona from New Mexico. Through service is also provided to California, Nevada, and Mexico on Arizona's natural gas pipelines. Arizona currently lacks major natural gas storage facilities, though several are being explored by private interest. Storage helps balance loads, avoiding shortages and price spikes in times of high demand.

In recent years, pipeline capacity has become an issue both for petroleum-based products and natural gas. In the summer of 2003, a pipeline rupture in the Phoenix region created supply issues and caused a rapid escalation of gasoline prices. Similarly, a lack of pipeline capacity through Arizona and other Western states contributed to California's natural gas shortage and power crisis of 2000 to 2001.

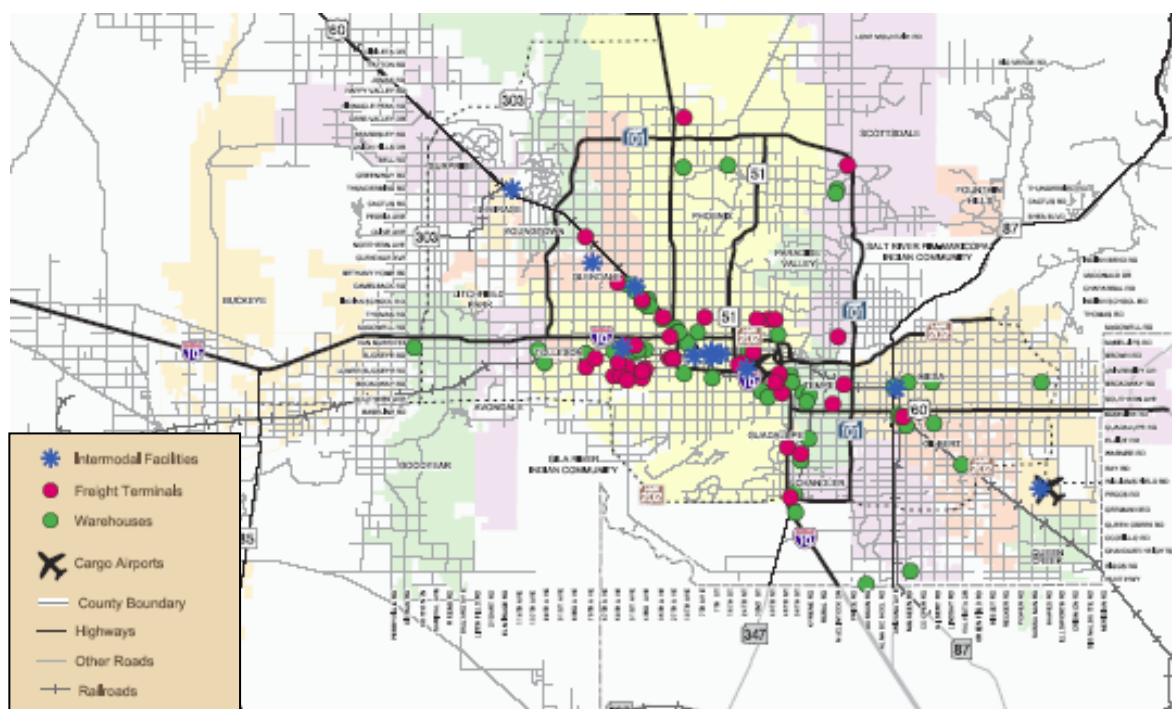
Intermodal Facilities

Intermodal facilities, such as airports, seaports, and train stations, provide transfer points and coordinate movements between various modes. There are 10 major freight highway-rail intermodal facilities in Arizona. Three are container cargo facilities, three are auto vehicle transfer points, three accommodate transfer of chemicals and chemical products, and one transfers liquid edibles. Seven of the facilities are located in the Phoenix metropolitan area, one is located in Parker, and two are located in Tucson.

MAG has worked extensively to document the freight infrastructure in the Phoenix metropolitan area, including intermodal facilities, freight terminals, and warehouses. Figure 8.3 shows that the majority of the freight-related facilities are located along the I-10 corridor, with another concentration of facilities along State Highway 60 northwest and east of downtown.

■ 8.2 Goods Movement and the Domestic Economy

Goods movement is a critical part of the Arizona and national economy, both in terms of output and employment. Based on the most recent (1997) U.S. Economic Census, the percentage of output in the goods-related sectors of the economy was nearly three-fourths of the output of the entire economy in Arizona (Table 8.3). The largest goods-related sectors are wholesale trade, retail trade, and manufacturing. These three sectors combined to account for over 60 percent of sales in 1997. Overall, the goods-related sector accounts for two-thirds of sales and 42 percent of total employment in the State.

Figure 8.3 Phoenix Region Freight Infrastructure

Source: Adapted from Maricopa Association of Governments Regional Transportation Plan, 2003.

Table 8.3 Economic Output and Employment by Sector for Arizona in 1997

Sector	Arizona Sales (\$1,000)	Percent of Total		Arizona Employees	Percent of Total	
		AZ	U.S.		AZ	U.S.
Wholesale trade	45,899,000	21%	23%	80,000	5%	6%
Retail trade	43,961,000	20%	14%	232,000	14%	14%
Manufacturing	43,030,000	20%	22%	194,000	12%	17%
Construction	19,115,000	9%	5%	132,000	8%	6%
Transportation, warehousing	4,086,000	2%	2%	45,000	3%	3%
Mining	3,069,000	1%	1%	13,000	1%	1%
All goods-related sectors	159,161,000	74%	66%	696,000	42%	45%
All services	56,121,000	26%	34%	945,000	58%	55%
All sectors	215,282,000	100%	100%	1,641,000	100%	100%

Source: U.S. Bureau of the Census, U.S. Economic Census, 1997

Goods Produced in Arizona

The FHWA created the Freight Analysis Framework (FAF) database to provide goods movement data by commodity and origin-destination pair at the state level. The top commodities, in terms of tonnage moved in Arizona, are shown in Table 8.4. The top four commodities represent 72 percent of the total tonnage produced in the State.

Table 8.4 High-Tonnage Commodities Produced in Arizona, 1998

Commodity	Internal	Outbound	Total (Produced in AZ)	Percent of Total
Clay, concrete, glass products	21,901,000	1,418,000	23,319,000	19%
Petroleum or coal products	21,114,000	2,055,000	23,169,000	19%
Nonmetallic minerals	22,976,000	69,000	23,045,000	19%
Secondary flows	15,486,000	2,280,000	17,765,000	15%
Food products	2,776,000	3,924,000	6,700,000	6%
Farm products	3,823,000	2,610,000	6,433,000	5%
Other commodities	7,780,000	13,278,000	21,058,000	17%
All commodities	95,856,000	25,634,000	121,490,000	100%

Source: Federal Highway Administration, Freight Analysis Framework, 1998.

Another way to examine the importance of particular commodities to Arizona is to examine the value of goods shipped. Though high-tonnage commodities have a disproportionate impact on the state transportation system, high-value commodities tend to add the most to the State's economy. The most recent data on the value of goods shipped comes from the 1997 Bureau of Transportation Statistics' Commodity Flow Survey (CFS). Table 8.5 shows the value of major commodities originating in Arizona, including shipments with destinations in Arizona. The electronics industry ships over 30 percent of the total value of goods shipped in Arizona. The five next largest commodities constitute 26 percent of the total value of goods shipped.

Table 8.5 Value of Arizona Shipments by Commodity, 1997

Commodity	Value (\$ mil)	Value %
Electronics, electrical equipment, office equipment	27,600	32%
Base metal in primary or semi-finished forms	4,700	6%
Miscellaneous manufactured products	4,400	5%
Motorized and other vehicles (including parts)	4,300	5%
Transportation equipment, not elsewhere classified	4,100	5%
Other prepared foodstuffs and fats and oils	4,000	5%
Machinery	3,800	4%
Other commodities	33,300	39%
All commodities	86,300	100%

Source: Bureau of Transportation Statistics, Commodity Flow Survey, 1997.

Direction and Mode of Goods Movement

Arizona is a net importer of goods. Table 8.6 shows that the tons shipped into the State are nearly twice that of the tons shipped out of State. This indicates that Arizona's domestic goods movement is focused on end consumption by the growing population. Over one-half of Arizona's total tonnage is shipped internally within the State. Looking to 2020, the overall tonnage shipped into, out of, and within Arizona is forecast to increase by 87 percent. Outbound commodity flows show the largest increase of all trip types, but Arizona will remain a net importer of goods (more inbound flows than outbound). Internal trips will continue to dominate the directional flow of goods.

Table 8.6 Forecast of Tons Shipped by Trip Type, 1998 and 2020

Trip Type	Thousand Tons (1998)	Thousand Tons (2020)	Percent Growth (1998-2020)
Internal	95,800	213,200	122%
Outbound	25,600	59,800	133%
Inbound	47,900	84,000	75%
Total	169,500	357,000	111%

Source: Federal Highway Administration Freight Analysis Framework, 1998.

The majority of goods in Arizona currently move by truck, and that trend is expected to be sustained into the future. Of commodities that originate or terminate in Arizona, approximately 143 million tons were shipped by truck (Table 8.7) – a considerable strain on the highway network. This total is expected to grow by 120 percent from 1998 to 2020, with over 300 million tons shipped by truck in 2020. Air freight is expected to be the fastest growing mode for goods movement in Arizona between 1998 and 2020. In 2020, however, air freight will still transport less than one percent (by tonnage) of all goods moved.

Table 8.7 Total Tons Moved by Mode, 1998 and 2020

Transportation Mode	Thousand Tons (1998)	Thousand Tons (2020)	Percent Growth (1998-2020)
Highway	143,200	314,700	120%
Rail	25,800	41,000	59%
Air	400	1,360	240%
Total	169,500	357,000	111%

Source: Federal Highway Administration Freight Analysis Framework, 1998.

■ 8.3 Goods Movement and the International Economy

In 2002, Arizona exported \$11.9 billion worth of goods (Table 8.8). This is a significant quantity, relative to the \$86 billion of domestic goods originating in Arizona in 1997. Arizona's largest export commodity is electrical machinery, accounting for over one-third of the total exports. Mexico is the largest single export country for Arizona, with \$3 billion of goods received. However, the shipments to all Asian countries exceeded the value of shipments to Mexico, with \$3.9 billion of goods received from Arizona. Access to port facilities in Southern California is crucial to the Asian export market and, thus, to Arizona's economy.

Trade between the United States and Mexico is an integral part of both countries' economies, particularly since the signing of NAFTA in 1993. Over 348,000 trucks crossed the U.S.-Mexican border into Arizona in 1999, carrying 242,000 loaded containers of freight. Nearly three-quarters of these trucks passed through Nogales (Table 8.9). This volume of trucks marks a 50 percent increase over the Sonora-Arizona traffic reported in 1991 to 1992.

Table 8.8 Destinations for Arizona's Exports in 2002

Region	Exports (Millions of Dollars)	Percent of Total
Asia (top 9 countries only)	3,900	33%
Mexico	3,000	26%
Europe (top 4 countries only)	2,100	18%
Canada	1,200	10%
<i>Total (top 15 countries)</i>	<i>10,200</i>	<i>86%</i>
Other	1,600	14%
Arizona Total	11,900	100%

Source: U.S. Census Bureau, Foreign Trade Division, 2002.

Much of the Arizona-Mexico border trade is related to the Maquiladora activity in the Sonora region of Mexico. The term Maquiladora refers to a manufacturing or processing firm that assembles component parts in Mexico that are temporarily imported from other countries, and returned to the origin country for final processing and sale. Maquiladora inputs include components, parts, and packaging materials used in the assembly or manufacturing process. As shown in Table 8.10, total inputs in 1997 for all of Mexico from all home countries were valued at \$36.4 billion, with 97 percent of all inputs imported. The industry mix of the Maquiladoras is similar to the industry mix in Arizona, including the electronics industry and transportation equipment.

Table 8.9 Arizona-Sonora Vehicle, Passenger, and Freight Border Crossings

Port of Entry	Personal Vehicles	Personal Vehicle Passengers	Buses	Bus Passengers	Trucks	Loaded Freight Containers
Douglas, AZ	2,150,100	5,912,800	NA	3,700	32,600	14,700
Lukeville, AZ	501,300	1,373,700	500	17,800	4,300	500
Naco, AZ	326,600	849,300	NA	1,400	7,800	5,900
Nogales, AZ	4,187,000	10,489,100	5,800	34,500	256,400	200,400
Sasabe, AZ	34,900	90,800	NA	NA	2,400	900
San Luis, AZ	2,687,400	6,505,800	100	700	44,800	13,700
Total	9,887,400	25,221,500	10,000	58,100	348,300	242,100

Notes: NA = Not available. Numbers may not add to total due to rounding.

Source: Bureau of Transportation Statistics.

Table 8.10 Inputs for Maquiladoras, 1997 (in Millions of Dollars)

Industry	Total Inputs 1997	Imported Inputs 1997	Percent of Inputs That Are Imported
Electronics	13,700	13,500	99%
Transportation equipment	7,800	7,700	99%
Machinery and equipment	5,200	5,200	99%
Apparel	3,200	2,700	83%
Other manufacturing	3,100	3,000	98%
Wood and metal furniture	1,100	1,100	94%
Other	2,200	2,000	93%
Total	36,400	35,300	97%

Source: Arizona-Mexico Commission, 1999.